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IRS Selects Zenith Z-171

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- New Trends In Integrated Software
- Hacking The Atari ST
- More About PC Clone Confusion
- Present — A "Video Slide Show"

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Applying The Atari

by Jeff Brenner

Graphics are no doubt one of the greatest specialties of the Atari computers. This month we'll take a look at Mirror Graphics, an exciting graphics routine, and we'll enter a mesmerizing application of this routine. I'm also providing an assembly listing of last month's translator-style-loading XL/XE CX-85 keypad driver. Our home budget program will be presented in June, instead of this issue.

Atari Help?

My editor has asked me to merge the "Atari Help" column into this column, and consequently "Atari Help" will no longer be presented as a separate article. While this puts an even greater restriction on my available space, you can be sure the program listings won't be made any smaller!

Selected portions of the what-was-to-be May "Atari Help" will be included in this month's column. Our home budget program (a real big one) has been pushed ahead a month to allow it to be presented in its entirety in one issue (rather than in two parts). Instead, we'll enter the amazing Mirror Graphics rountine.

Reader Mail

Q. I read your column regularly and I've learned many things and found many useful programs. I have recently purchased an Atari 130XE and so far it seems to be the "perfect" home computer. Can you tell me the pros and cons on this computer?

In copying various programs from different magazines; a Solitaire game I recently copied, for example; versions for other computers display the cards in color. Would you please comment on this matter? Could it be that the writers perhaps limit the Atari versions to the older machines? I also read that the October 1985 issue had a program, Super Clock and the September 1985 issue had Response Analysis Program. Are these programs still available?

Kathryn E. Fields
Seminole, Alabama

A. The Atari 130XE is an excellent home computer, and probably the best 8-bit value on the market. The 130XE, like any computer, has its pros and cons, but I won't go into the specifics here. By taking advantage of the thousands of programs available for the 130XE (the 130XE will run all XL software and most 400/800 software) and the newer 130XE-specific programs (which take advantage of the XE's 128K RAM), you'll be able to get the most out of this versatile computer.

Regarding the solitaire game that worked only in black and white, this is probably due to the graphics mode that game was programmed to operate in. The Atari 130XE has a single color 4]-column text mode, two color text modes, various color graphics modes nad one, high-resolution, single color graphics mode. In the solitaire game you refer to, I would suspect that the author chose to take advantage of the Atari's built-in card character graphics. You can see these characters on the screen by holding down the CONTROL key and pressing the keys that have the heart, diamond, spade and club imprinted on the front-side of the keys. The author could have used a high-resolution, four-color mode to draw the cards, but probably did not feel it was worth the effort, particularly if this progarm was translated from another machine. Both the older Ataris and the 130XE share the same graphics capabilities, so this is not the result of ensuring compatibility with the older Atari models.

I have prepared a listing of back-issue diskettes of the programs that have appeared in this column and am sending you a copy. This list has been sent to all readers who have requested it. Other readers who want the back-issue diskette list can send me a self-addressed, stamped envelope.

Q. Where can I get the master disks for DOS 2.0 and 2.5? I have written the Atari Co. about this but have received no reply.

B. F. Roberts
Arlington, Virginia

A. Atari has placed the DOS 2.5 files in the public domain and the files can be found on many Atari bulletin boards. If you have a modem, you can download the files to make your own master diskette. DOS 2.0 is not necessary once you have DOS 2.5, since all the functions of DOS 2 (including single density formatting) can be performed through DOS 2.5. DOS 2.5 is also provided on the monthly "Applying The Atari" diskettes (see end of this article). The various DOS 2.5 utilities are provided on the diskette upon request.

If you own DOS 3, you can send it in to Atari for a DOS 2.5 replacement at no charge. Send the DOS 3 diskette to Atari Customer Relations, P.O. Box 61657, Sunnyvale, CA 94088. I have recommended several times in the past that readers make this swap for DOS 2.5 since DOS 3 is incompatible with many commercial products and has various other quirks.

A detailed manual on DOS 2.5, *Atari DOS 2.5 Manual*, is available from Atari (customer relations address above) for $12.50, postpaid. Good luck!

Q. I've been having fun with PixMix Puzzle Machine (March 1985) which works as advertised. I have discovered a couple of weirdnesses in program entry/execution which some of your readers may run into as well. Thought I'd pass them along:

When I ran PixMix for the first time, I had no visible cursor; only when moved over a light area on the screen was it possible to "see" where it was. I checked the published listing and my entry again and found no errors--and finally, it came to me: the old Atari variable table hoo-haa! Sure enough, when I listed the variables (with Monkey Wrench), there were some ininvited visitors at the top of the table. LISTing the program to disk, the ENTERing it back in with a final SAVE cleared the variable table and produced the flashing cursor (in color!).

Now, I'm not sure why this happened, but I suspect: 1) Some possible interaction with Program Perfect (did you warn us to LIST the completed entry to disk, etc?) or 2) Having SAVEd the program after loading CLOCK.PIC into memory, may have forced some spurious variables into the main PixMix BASIC program.

I'm sure you can tell me what went on.

I also wonder if the "Disk or Cassette" prompt could easily be skipped, since almost everyone is using disk drives now. If so, how? It would also be nice to have a "GIVE UP" option for a hopelessly scrambled picture. Perhaps PEEKing OPTION to re-run the program; but then, we may have the problem of the current picture crammed into memory. Any thoughts on this?

John H. Doyle
Atlanta, Georgia

A. You and many other Program Perfect users have stumbled upon a subtly-introduced error that affects the PixMix cursor. Your first suspicion is indeed correct; an interaction with Program Perfect is the fault.

PixMix resets the memory address of the first string in the variable table (normally PM$, the first string in the program) to point to the player/missile cursor data. This allows rapid movement of the cursor (a player) by simple BASIC string manipulations instead of additional machine language subroutines. Unfortunately, when Program Perfect is used to enter PixMix, the first variable in the variable table is a Program Perfect variable, instead of PM$. Consequently, some other variable is pointed to the player/missile data, and PixMix's manipulations of PM$ have no effect on the cursor.

The very simple solution, as you have noted, is to LIST the program to diskette (i.e. LIST "D:TEMP"), type NEW, ENTER the program back in again (ENTER "D:TEMP") and then SAVE the program back to diskette (i.e. SAVE "D:PIXMIX.BAS"). Typing NEW clears the Atari variable. ENTERing a LISTed program back into the computer is the equivalent of retyping the program and the effect is to place PM$ as the first variable in the Atari's variable table, where it belongs. SAVE and LOAD do not correct the location of PM$ since the variable table is saved and loaded along with the program. Therefore, only the LIST, NEW, ENTER sequence can be used.

It is always a good idea to LIST a program that is not functioning properly, type NEW, and then ENTER it again, particularly when writing your own programs. This can free up unused variables and memory and lets you start off "fresh," as if you had just typed the entire program into the computer.

A simple way to skip the "Disk or Cassette" prompt is to add this line:

215 POKE 764,58

This makes the Atari think you have pressed the "D" when you are asked to press a key. Cassette owners (yes, there are still some of them out there) should add:

215 POKE 764,18
(for cassette owners)

A "quit"option is similarly simple to implement. There's no need to worry about the current picture in memory, since the next picture that is loaded in will simply overwrite the old one. Add this line:

545 IF PEEK(764) = 28
THEN GRAPHICS
40:GOSUB 720:GOTO 890

Now, pressing the ESC key will interrupt the current puzzle and bring you to the "Same or New puzzle" prompt.

Q. When I put programs on disk and I want to run them, I have to type the game file name that I want to play. Is there any type of menu program I could use? Help!!!

Al Wallace
Laflin, Pennsylvania

A. There are literally dozens of such menu progams floating around in the public domain. Some will load only machine language programs, others only BASIC programs, while still others will load both. I am sending you a diskette containing a few menu programs that you can experiment with. I'll include these programs, on request, on this month's diskette for other readers interested in them. (See end of this column for information on purchasing the monthly diskette.)

Q. I have found something that has always puzzled me until I have been frustrated by it while trying to type in a program from a magazine. I have looked through my Atari books and can't find what keys to press to make these characters appear on the screen ({,}). I have two programs that I can't type in until I can type these characaters.

Michael B. Jones
APO, New York

continued on page 70

Listing 1

```
10 ; CX85 KEYPAD DRIVER
20 ; COPYRIGHT 1986 JEFF BRENNER
30 ; USE JOYSTICK PORT 2
40 ; INSTALLED WITHIN OPERATING SYSTEM (O.S.) OF ATARI XL
50  *=$600 ; ADDRESS DOESN'T MATTER SINCE RAM WILL BE CLEARED BY COLDSV
60 STICK1=633 ; FOR JOYSTICK PORT 2
70 POT3=53763
80 TRIG1=53265
90 CH=764
0100 ;
0110 ; FIRST COPY O.S. ROM INTO RAM UNDERNEATH
0120 ; ------------------------------------
0130 INIT SEI       ; DISABLE IRQ'S
0140  LDA #0
0150  STA $D40E ; DISABLE NMI'S
0160  LDX $D301 ; HOLD ORIG. CONTENTS OF PORTB
0170  LDY #0
0180 LOOP LDA $C000,Y ; GET BYTE FROM ROM O.S. (STARTS AT $C000)
0190  DEC $D301    ; ENABLE RAM
0200 HERE STA $C000,Y ; STORE BYTE IN RAM, UNDER O.S. ROM
0210  STX $D301    ; RE-ENABLE ROM
0220  INY
0230  BNE LOOP
0240  INC LOOP+2  ; INCREMENT HIGH BYTE OF ADDRESS $C000 IN LDA $C000,Y
0250  INC HERE+2
0260  LDA LOOP+2
0270  BEQ FINISHED ; IF $0000, WE'VE PASSED $FFFF SO WE'RE DONE
0280  CMP #$D0   ; CHECK IF REACHED HARDWARE REGISTERS
0290  BNE LOOP  ; IF NOT, COPY SOME MORE
0300  LDA #$D8  ; IF SO, NOW COPY O.S. FROM $D800
0310  STA LOOP+2
0320  STA HERE+2
0330  BNE LOOP
0340 FINISHED DEC $D301 ; REENABLE RAM O.S.
0350  CLI
0360  RTS ; RETURN FROM INITIALIZATION
0370 ; FOLLOWING IS CONTAINED AT THE RUN ADDRESS
0380 RUNADR LDA #0
0390  STA $D40E ; DISABLE NMI'S AGAIN
0400  LDX #$05
0410  STA $D40A
0420 PAUSE DEX     ; WAIT A LITTLE WHILE BEFORE CHANGING VBI VECTOR
0430  BNE PAUSE
0440  LDA #$4C  ; ADD OUR KEYPAD DRIVER AS AN EXTENSION TO THE ATARI'S
0450  STA $C28A ; ACTUAL VERTICAL BLANK ROUTINE
0460  LDA #START&255
0470  STA $C28B
0480  LDA #START/256
0490  STA $C28C
0500  LDA #LINK&255
0510  STA $C485 ; REDIRECT PORTION OF XITVBV ROUTINE
0520  LDA #LINK/256 ; TO PREVENT ROM O.S. FROM BEING REACTIVATED
0530  STA $C486
0531  LDA #DETOUR1&255
0532  STA $C4C2
0533  LDA #DETOUR1/256
0534  STA $C4C3
0535  JMP SKIPIT
0540 DETOUR1 CLC ; O.S. DETOUR TO PREVENT CLEARING RAM O.S. MEMORY
0550  ADC #$10
0560  STA $06
0570  CMP #$C0 ; REACHED $C000?
0580  BCS YEP
0590  JMP $C4B1
0600 YEP RTS
0610 SKIPIT LDA #$40
0620  STA $D40E ; REENABLE NMI'S
0630  LDY #79 ; PUT OUR MESSAGE ON FIRST TWO LINES OF SCREEN
0640 MORE LDA MSG,Y
0650  SEC
0660  SBC #32
0670  ORA #128
0680  STA (88),Y ; STORE IN SCREEN MEMORY
0690  DEY
0700  BPL MORE
0710 WAIT LDA $D01F
0720  AND #$02
0730  BNE WAIT ; WAIT UNTIL SELECT KEY PRESSED
0740  LDA #0
0750  STA 8
0760  JMP $E477 ; NOW SIMULATE POWERUP SO NEW PROGRAM CAN BE BOOTED NOW
0770 ; THAT OUR RAM O.S. RECOGNIZES THE NUMERIC KEYPAD
0780 LINK LDA $D301
0790  STA $CFFF
0800  JSR $C4DA ; THIS SECTION ADDED TO COLDSV TO REENABLE RAM O.S.
0810  LDA #$FE
0820  STA $D301
0830  LDA $CFFF
0840  STA $D301
0850  RTS
0860  *=$CC00 ; THIS PART LOADED INTO INTERNATIONAL CHARACTER SET MEMORY
0870 ; FOLLOWING SECTION IS AN O.S. DETOUR TO PREVENT ROM O.S. FROM
0880 ; BEING REACTIVATED DURING COLD START
0890 ; ACTUAL KEYPAD DRIVER FOLLOWS
0900 START LDX TRIG1
0910  BEQ PRESSED         ; IF TRIG1=0 THEN KEY HAS BEEN PRESSED..
0920  DEX
0930  STX FLAG            ; OTHERWISE KEY IS RELEASED - STORE ZERO IN FLAG
0940  BEQ END             ; JUMP TO END
0950 PRESSED LDX STICK1
0960  CPX LAST            ; CHECK AGAINST LAST KEY PRESSED
0970  BNE SKIP2           ; IF DIFFERENT, IGNORE FLAG
0980  LDA FLAG
0990  BNE END             ; IF FLAG NOT 0, CANNOT READ KEY YET
1000 SKIP2 LDA HOLD           ; CHECK HOLD TO SEE IF TWO VBI's PASSED
1010  BEQ READKEY         ; IF HOLD=0, READ THE KEYPAD
1020  DEC HOLD            ; ALLOW ANOTHER VBI TO PASS BEFORE READING
1030  BEQ END
1040 READKEY INC FLAG     ; SET FLAG TO NON-ZERO VALUE SINCE KEY IS PRESSED
1050  STX LAST            ; SAVE THIS KEY VALUE
1060  INC HOLD            ; SET HOLD TO NON-ZERO VALUE
1070  LDA POT3            ; CHECK IF ESCAPE PRESSED
1080  CMP #1
1090  BEQ NOESC           ; IF POT3=1 THEN ESCAPE WAS NOT PRESSED
1100  LDX #16             ; LOAD X WITH OFFSET FOR ESC KEY
1110 NOESC LDA DATA,X     ; GET DATA DETERMINED BY X OFFSET
1120  STA CH              ; STORE DATA IN KEYBOARD CODE REGISTER
1130 END PLA  ; NORMAL EXIT VERTICAL BLANK ROUTINE
1140  TAY
1150  PLA
1160  TAX
1170  PLA
1180  RTI
1190 ; DATA FOR KEYS FOLLOWS
1200 DATA  .BYTE 52,24,29,27,35,51
1210  .BYTE 53,48,43,31,30,26
1220  .BYTE 50,34,12,14,28,155
1230 FLAG .BYTE 0 ; RESERVE VARIABLES FOR ROUTINE
1240 HOLD .BYTE 0
1250 LAST .BYTE 0
1260 MOVE LDA #$04 ; FOLLOWING COMMANDS ASSEMBLED FOR THEIR DATA, TO BE
1270  STA $01 ; MOVED TO $C2DC
1280  LDA $06
1290  STA $05
1300  LDY #0
1310  JMP $C2FD
1320 MOVE2 LDA #$A0 ; MORE COMMANDS FOR ASSEMBLY, MOVED TO $C4A9
1330  STA $06
1340  LDA $A000
1350  EOR #255
1360  CMP $A000
1370  BNE ROM
1380  EOR #$FF
1390  STA $A000
1400  LDA #$C0
1410  STA $06
1420 ROM RTS
1430 MSG  .BYTE "CX-85 KEYPAD DRIVER - (C)1986 J. BRENNER"
1440  .BYTE "INSERT PROGRAM DISKETTE AND PRESS SELECT"
```

Applying The Atari

continued from page 69

A. Nowadays, it is rare to find non-Atari characters in a printed program listing. Most magazines will either convert the characters to CHR$ codes (as I usually do with "Applying The Atari" listings) or list them using a utility that can print the actual Atari characters (such as the July 1985 ATASCII Lister). Sometimes older programs, however, do show these characters. The most typical example is the closed bracket that you mention. On the Atari, character 125 is used to clear the screen and appears in a program listing as the counterclockwise-twised arrow. The standard ASCII character 125, however, is this closed-bracket symbol. Hence, when a program containing this character is listed to a standard printer, the bracket symbol appears instead of the twisted arrow.

The programs that you are having trouble with should tell you what to replace these characters with. Or, the function might be mentioned in a REM statement on the program line itself. For example:

10 PRINT ";":REM CLEAR SCREEN

would indicate that the printed character should be replaced with a clear screen character.

If no further instruction is given, your alternative is to check an ASCII character chart (found in most printer manuals), find the offending character and look up its ASCII code. Then replace the character with a CHR$ (CODE), where CODE contains the ASCII code for the non-Atari character. The closed-bracket that you mention would therefore be typed as CHR$(125).

Memory Update

Newell Industries' 256KXL Memory Upgrade for the 800XL includes MyDos and now allows the user to switch ANTIC between main and banked memory. It's $79.95 ($49.95 without RAM). Contact: Newell Industries, 602 E. Hwy. 78, Wylie, TX 75098.

Newsletters

We're still receiving new and interesting newsletters from Atari groups from all over the country. This month's mail brings newsletters from the Huntsville Atari Users' Group (3911 W. Crestview S.W., Huntsville, AL 35816) and from the Rockford Atari Computer Club (c/o Roger Creedy, 3206 Sunnyside Drive, Rockford, IL 61111). Does your group publish a newsletter? If so, send it in!

CX-85 Assembly Listing

Listing 1 is the assembly listing of last month's CX-85 keypad driver, for those who want to study how it works. I'm still working on a general CX-85 driver for the 800. It's not going to be an easy task since it's very difficult to find a good place in memory for such a routine. Also in the works is a SynCalc-specific keypad driver for the XL/XE, since this is the most popularly requested driver. Several articles in Atari users' group newsletters have expanded on the original keypad subroutines published in July 1985. Hopefully some industrious individual out there has already come up with an 800 driver and a SynCalc keypad driver. If so, please let us know--you'll gain the appreciation of thousands of keypad owners!

Autorun Directory

Listing 2, as promised last month, creates an AUTORUN.SYS file on a diskette that will automatically run a file named "D:DIR" when the

continued on page 180

LISTING 2

```
NGJ 10 REM CREATE AUTORUN.SYS PROGRAM
AIJ 20 REM WILL RUN "D:DIR" ON DISK
CIJ 30 PRINT "INSERT DISK CONTAINING THE DIR ROUTINE"
WZJ 40 PRINT "PRESS START WHEN READY TO WRITE FILE."
JIJ 50 IF PEEK(53279)=7 THEN 50
VJJ 60 OPEN #1,8,0,"D:AUTORUN.SYS"
ARJ 70 FOR I=1 TO 134:READ N:PUT #1,N
NRJ 80 NEXT I:CLOSE #1:PRINT "FINISHED."
NYJ 90 END
TFJ 100 DATA 255,255,160,6,162,6,76,175
OYJ 110 DATA 6,175,6,251,6,160,11,185
SWJ 120 DATA 0,228,153,163,6,136,16,247
VCJ 130 DATA 169,222,141,167,6,169,6,141
ROJ 140 DATA 168,6,172,170,6,174,169,6
UEJ 150 DATA 232,208,1,200,142,246,6,140
TJJ 160 DATA 247,6,169,163,141,33,3,169
JHJ 170 DATA 6,141,34,3,96,172,0,6
QXJ 180 DATA 208,10,169,0,141,33,3,169
PBJ 190 DATA 228,141,34,3,185,1,6,206
MMJ 200 DATA 0,6,72,32,251,6,104,160
PDJ 210 DATA 1,96,253,6,255,6,108,250
FKJ 220 DATA 191,68,2,68,2,0,9,0
ITJ 230 DATA 9,0,1,226,2,227,2,160
IVJ 240 DATA 6,224,2,225,2,253,6,0
JUJ 250 DATA 6,10,6,9,155,82,73,68
DOZ 260 DATA 58,68,34,78,85,82
```

MIRROR GRAPHICS

```
NLJ 25000 REM MIRROR GRAPHICS
QAJ 25010 REM COPYRIGHT 1986 JEFF BRENNER
JDJ 25020 TOT=0:I=0
FQJ 25030 READ NUM:IF NUM=-1 THEN 25060
LGJ 25040 POKE 1536+I,NUM:I=I+1
XDJ 25050 TOT=TOT+I+NUM:GOTO 25030
NXJ 25060 IF TOT=36083 THEN 25090
HJJ 25070 PRINT "ERROR IN DATA LINES."
XZJ 25080 STOP
EYJ 25090 RETURN
RBJ 25100 DATA 104,165,205,133,204,198
POJ 25110 DATA 204,165,88,133,208,165
PQJ 25120 DATA 89,133,209,166,206,134
REJ 25130 DATA 203,165,205,133,213,198
NDJ 25140 DATA 213,169,0,133,212,164
NOJ 25150 DATA 213,177,208,141,255,6
JLJ 25160 DATA 162,0,134,207,162,8
LJJ 25170 DATA 110,255,6,38,207,202
RPJ 25180 DATA 208,248,165,207,164,212
PHJ 25190 DATA 17,208,145,208,230,212
RPJ 25200 DATA 198,213,196,204,208,219
OWJ 25210 DATA 24,165,208,101,205,133
NDJ 25220 DATA 208,165,209,105,0,133
RLJ 25230 DATA 209,166,203,202,208,189
CSJ 25240 DATA 96
QMJ 25250 DATA 104,104,133,203,104,133
NVJ 25260 DATA 207,24,165,88,133,208
PKJ 25270 DATA 101,207,133,212,165,89
QTJ 25280 DATA 133,209,101,203,133,213
RUJ 25290 DATA 166,206,164,205,136,177
PFJ 25300 DATA 212,17,208,145,208,136
NHJ 25310 DATA 16,247,24,165,208,101
RDJ 25320 DATA 205,133,208,165,209,105
LJJ 25330 DATA 0,133,209,56,165,212
RCJ 25340 DATA 229,205,133,212,165,213
MWJ 25350 DATA 233,0,133,213,202,208
QHZ 25360 DATA 215,96,-1
```

ATARI ST

Hacking The Atari ST

by Wynn Rostek

Thank you very much. We have had very good response to our articles on the Atari ST. Stan Veit has backed the new machine from the start. Now that the Atari ST has been on sale for almost a year, and it looks like it is going to be a winner, every magazine is starting to provide coverage. We just thought you should know that the *Computer Shopper* is not jumping on the band wagon, they have been leading the band wagon! Stan is too modest to point this out, but we felt the truth should be known.

Due to the popularity of the new ST computers from Atari, we have been asked to start a series of articles exploring the inner workings of the ST. This is the first article in the "Hacing the ST" series. We hope to provide descriptions of the inner workings of the ST, some examples of how to use the special features of the machine, and a smattering of hardware projects.

Since programming in assembly language, or wiring up circuits isn't everyone's idea of fun, we will try to keep from having an article completely devoted to a single topic. Instead we will try to have a little something for everyone from the beginner to the computer scientist in every article.

The series is designed to help you get the most out of your ST. Since we assume that you are a hands-on person, we will not be reviewing general purpose programs, or books about the ST in this series. We will be looking at programming tools and books about programming on the ST. as long as they are helpful to the person trying to get the maximum performance from the ST.

We have not forgotten the interested reader or students, or regular ST owner, the *Computer Shopper* will continue support the general ST user, it just won't be in this column.

The first topic we will discuss in this issue just happens to be a book on the ST. Readers that have been following our coverge of the ST will recall that the first book out on the ST was *Presenting The Atari ST* from Abacus Software. We were not very enthusiastic about this particular book, because of the lack of specific information on the system. Abacus has just released two new books in the ST series.

Atari ST Internals, The Authoritative Insiders Guide is the second book in the series and this book is filled with specific information on the ST. The book is broken into three main sections. Chapter 1 covers the chips used by the ST. The second chapter covers the interefaces. Chapter 3 covers the system software.

The book also includes a bios listing for the first version of TOS and information on the system fonts. The sections on the M68000 CPU leave a lot to be desired. It is plain that this section has been translated word-by-word from German. The result is a stilted, grammatically confusing description of the 68000's operation. In several cases, the information presented is just plain wrong! (This may be a result of the translation, these errors are in mainly who does what to whom.)

Since the M68000 CPU is the heart of the ST, a good understanding of its operation is required for anyone who is serious about the machine. The information in *Atari ST Internals* falls far short of what is required. There is another book which we will mention later in this column that provides excellent coverage of the M68000.

A lot of the work in the ST is performed by the four custom chips. The main interface between the CPU and the dynamic RAM is the MMU (Memory Management Unit) chip. The MMU chip takes care of generating the RAS and CAS signals for both banks of memory. (A standard 520 ST has only one bank of RAM, the 1040d and modified 520s have two banks.)

Since the M68000 can perform byte and word reads and writes (8 and 16 bit) the MMU generates two CAS signals for each bank. The first CAS is used for high order byte and the second CAS signal is used for the low order byte.

The GLUE chip contains several functions. The GLUE chip acts as a memory decoder for the other chips used by the ST. (The Disk controller, MFP, video generator, DMA, and the 6850s used for the keyboard and MIDI.) It also contains circuitry to generate the BUS ERROR condition for asynchronous bus transfers.

The DMA chip is really a parallel I/O device with bidirectional data lines. It works in conjunction with the other chips to perform DMA (Direct Memory Access) transfers.

The SHIFTER chip is a parallel-to-serial converter that loads information from the dynamic RAM and feeds it to the video circuitry of the ST.

We found the description of the GLUE, MMU, DMA and SHIFTER chips very sparse in the *Atari ST Internals* book. A couple of readings will clear up most of the mystery and give you some insight of how the chips work within the system, but you really need to look at the BIOS and Extended BIOS functions to understand what is happening.

The ST uses a Western Digital WS-1772 Floppy Disk Controller chip for interfacing to the 3½ drives on the ST. The section of *Atari ST Internals* on the WD 1772 disk controller is pretty good, but most of you will not need to play with the WD 1772 chip directly. There is plenty of information available here to keep you busy for a long time.

An MFP 68901 is used in the ST to provide the serial interface, counter/timer used by the system, and a small amount of parallel I/O. The description of the 68901 contained in the book is detailed enough that you can probably get away with not obtaining the Motorola manual on it, the same cannot be said for the M68000 C.P.U. itself.

The ST uses a pair of M6850 serial I/O chips to talk to the keyboard and the MIDI port. The 6850 ACIA coverage is good, and you will not need additional information on these chips. The coverage of the YM-2149 sound chip used by the ST is also very good.

The M68000 uses memory mapped I/O, so there are no separate I/O instructions. Section 1.7 of *Atari ST Internals* gives the addresses of registers for all the support chips. It is a good idea to read this section *before* trying to tackle the section on the GLUE, MMU, DMA and SHIFTER chips.

The section on interfaces is very worthwhile. The description of the keyboard (which has its own CPU) is excellent. Compared to the information that Atari has supplied, this is a real treasure chest. The Mouse interface is also covered very well. The description of video interface is little more than a drawing, but has proved to be more than enough.

The Centronics and serial interfaces are treated very briefly, but as these are standard interfaces, it should prove adequate. The MIDI interface section could have used some beefing up, in light of how useful this is for non-MIDI applications. (Look forward to some hardware projects using this interface.)

The pinouts are given for the cartridge slot, and the authors note that the slot is read-only, even fly-wiring the R/W signal will not prevent the bus error signal from being generated by the GLUE chip. The floppy disk interface is standard except for the oddball connector that Atari choose. The book gives the function of the 14 pins used.

The DMA connections are described, but not enough information is given to allow use of it. If you want to use the DMA port, you'll have to do some digging to get the information you need.

GEMDOS is the workhorse of the ST, it has most of the functions you need for generating serious programs. It also happens to be a clone of MS DOS 2.0 for the M68000. While GEMDOS is not an exact copy, many of the functions of MSDOS are there. Most of the differences between GEMDOS and MSDOS are a result of the lack of support for the more primitive disk functions that were used on earlier versions of MSDOS. GEMDOS provides the UNIX-like file functions from MSDOS.

Atari ST Internals provides a paragraph or two, for most of the GEMDOS functions. The description provided allow you to use the DOS calls, but we have found that it is better to use an MSDOS manual for several of the calls. For the most part, this section of the book is pretty good. (Function 0x31 is one of the functions that is better explained by the MSDOS manual.)

The sections that explained the BIOS and Extended BIOS calls are very good. There are also few other places to get this information. If you purchase the ST developers kit from Atari, you will receive *A Hitchhikers Guide To BIOS* which contains a more detailed description of these functions.

Atari ST Internals contains 27 pages of information on the line A interface. This is the best information we have found to date on the line A interface even though it is incomplete in

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Compubridge™ For The Atari 520 ST

Artworx has begun shipments of its popularly priced bridge tutorial, COMPUBRIDGE, for the Atari 520 and 1040 ST computers. COMPUBRIDGE joins BRIDGE 4.0 in Artworx' expanding line of software for the ST family of computers. All user input to COMPUBRIDGE is by mouse, no keyboard entry is required. The program can be backed-up, and the code is accessible to the curious user.

Based on the bridge text *Contract Bridge, Five-Card Major Approach* by Silverman, Jais and Lebel, COMPUBRIDGE consists of 10 "chapters" covering all aspects of the game from the very basics to understanding tricky finesses. A unique feature of the program is a series of quizzes associated with eight of the chapters. Each quiz is randomly generated so that no matter how many times COMPUBRIDGE is used, there will always be a different set of cards for each quiz. This is particularly useful for the advanced player interested in "fine-tuning" his game.

COMPUBRIDGE for the ST lists for $29.95. It makes the perfect companion program to Artworx' bridge playing program, BRIDGE 4.0.

For more information contact: Artworx Software Company, Inc., 150 North Main Street, Fairport, New York 14450. (800) 828-6573. In New York (716) 425-2833.

Mention that you read about it in *Computer Shopper*. ●

Hacking The Atari ST
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places. The line A interface is really a series of illegal opcodes for the M68000. These opcodes cause an exception when they are encountered. The exception causes a graphics generating routine to execute, which actually places the dots on the screen.

We will be playing around with the line A interface quite a bit in the early part of this series. The line A interface will allow you to generate graphics without having to link in and use the VDI and AES portions of GEM. This is perfect for generating graphics from assembly language.

The section on exceptions and interrrupts is thin, there is a lot more to these functions than this part of the book would lead you to believe. On a machine as heavily interrupt-driven as the ST, a more thorough treatment is needed.

The book also contains the screen control codes for the ST display. This is very handy information to have. It also has a short section on the system variables which is comparable to the section in the *A Hitchhikers Guide to the BIOS* from Atari.

The book also contains a short (and probably useless) section in the instruction set of the M68000. The balance of the book is a listing of an early version of TOS. This listing is very valuable, it is a little out of date, but heavily commented.

All in all, *Atari ST Internals* is worth the $19.95. If you are serious about the ST, and don't want to plunk down the money for the developers kit, you may still want to buy a copy. The book is a lot more handy than the 3000 loose pages of scattered information Atari provides, and you can always look things up in the developers kit if the *Atari ST Internals* treatment is incomplete. I tend to leave *A Hitchhikers Guide to the BIOS* and *Atari ST Internals* laying on the desk with the computer.

The devleopers kit from Atari is $300. If you are interested, call (408) 745-4926 and ask for Richard Frick. (Richard is very busy, so you will probably have to speak to whoever you can get on the line.) The developers kit contains a lot of documentation but a lot of it is not exactly on the ST. You get a *CP/M 68K Programmer's Guide*, and then there is a section in *A Hitchhikers Guide to the BIOS* that gives corrections and explains the difference between the ST and the CP/M 68K ver-

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Randy's Atari ST Column
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design phase and the database entry/processing phase. During database design, several "splats" (pre-defined fields and lengths) are provided that can be clicked onto the screen. They include a mailing list splat which can be "customized" by adding fields in addition to the mailing list fields. The order of the fields are according to your selection, but if you decide to use the mailing list splat and add other entries, take care not to change any of the field names or lengths, otherwise during the report phase DB Master One won't recognize the list fields. The ability to have mailing list fields along with adding other fields I found attractive enough to convert my data over from my Multiplan spreadsheets over to DB Master One, as can be seen from the Redesign screen of one of my own files called NEWLIST1 ONE. The database design phase also allows you to display the field labels and the field data in varying point sizes, colors, and forms. The mouse is used to expand and contract the label and data field sizes, and by clicking and holding the button, the field can be moved to a different portion of the screen. DB Master One only scrolls vertically, there is no horizontal scrolling. Its a little confusing at first in setting up the fields on the screen, but in a short time it becomes rather easy to whip up a screen suitable for use.

Entering the data in DB Master One is also a little confusing at first: once you have entered your data you hit the enter key to go on to the next field, or use the mouse and move to the next field you want to enter data. Fortunately, you don't need to use the mouse to add a record, or to get the next record, judicious use of the control keys do quite nicely (control A, to add a record; Control B, to delete a record; etc).

Reporting modes under DB Master One gives you the ability to print a report in a columnar format, a page format, the entire record or mailing list. In addition, you can selectively pick out certain elements from the database to report on. DB Master One also has a CONTAINS option, whereby it looks for a particular data sequence no matter where it is in the field; it acts like a substring operation in most programming languages. The report can be sent to disk, the printer or even to the screen (using the 6 x 6 bit-mapped font (for inspection).

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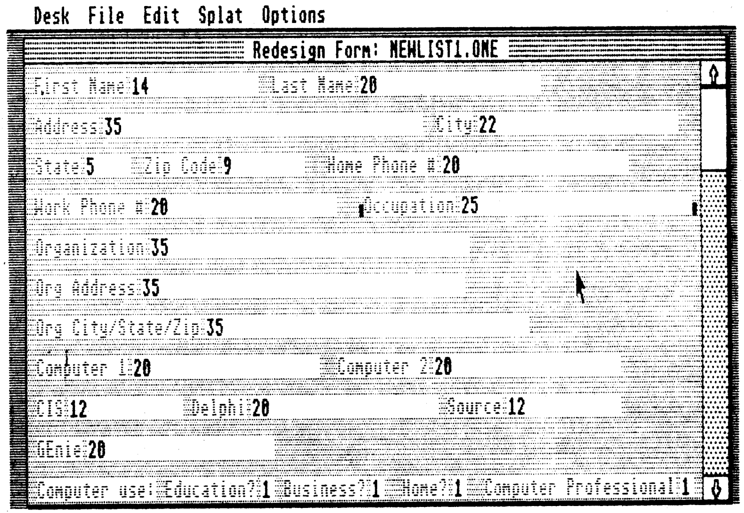

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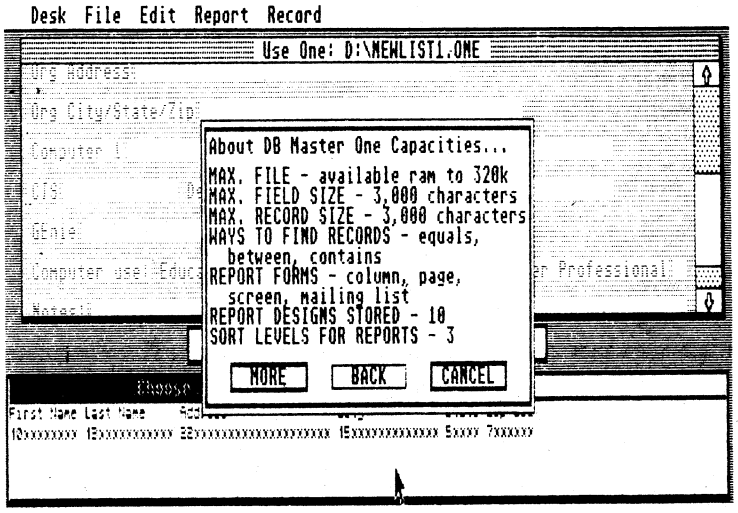
CIS 12 Delphi 20 Source 12
GEnie 20
Computer use: Education? 1 Business? 1 Home? 1 Computer Professional 1

Fig. 5 — DB Master One Screen Design



About DB Master One Capacities...
MAX. FILE - available ram to 320k
MAX. FIELD SIZE - 3,000 characters
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WAYS TO FIND RECORDS - equals, between, contains
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Fig. 4 — DB Master Specs

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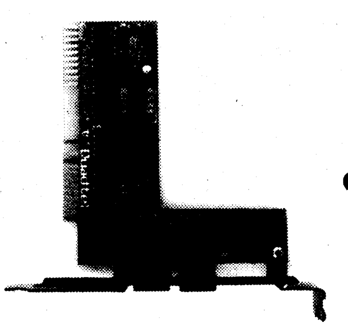

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Both touch-tone and pulse dialing are supported by **SideDialer**. For more information see your local dealer or contact:

Quadtel
2030 E. 4th Street, Suite 234
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Dealer inquiries are welcome.

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GAME CARD - (2 Joysticks) $25
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256K/640K 8-SLOT TURBO (6.77 MHz) MOTHERBOARD $149
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5152-STYLE KEYBOARD - (Enhanced AT-Style Keyboard w/Separate Num Pad) $89
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Hacking The Atari ST
continued from page 133

sions of Command Files. This find of treatment is common throughout the documentation. There is very little information that is custom generated for the ST.

In addition to the documentation, you get a text editor (Micro EMACS) and a C compiler. The C compiler has a few rough edges (Scanf doesn't terminate with a return, you have to use a linefeed.) but is workable. The assembler and linker supplied are disk intensive. You are in for a lot of waiting if you run them off of a floppy disk.

$300 is a lot of money for most people to spend on a hobby. If you are doing commercial development on the ST buy the developers kit. If you are a serious amateur, you can get away with *Atari ST Internals* and an assembler for the time being.

The second book we would to tell you about is *Programming the 68000* from SYBEX. Steve Williams does an excellent job of explaining the instruction set of the M68000. Each instruction is given a page that gives a brief description of the instructions action, the allowable addressing modes the data sizes and the affects on the condition code flags. He also gives the machine code format of the instruction and an example of the instruction being used.

Steve's explanation of addressing modes and stack frames is very good. He also provides some simple programs, and chapters on I/O programming, advanced concepts, exception processing and even a simple Operating System for a M68000 based machine. While the programs and I/O sections are using CP/M 68K, there are enough similarities that you can still get a lot of good out of these sections. (He uses the same C compiler, assembler and linker that is distributed with the ST developer's kit, but is running them under a different OS so system calls are different.) $22.95 is a small price to pay for this book, consider it a "MUST" for anyone working with the ST.

This month, we would to take what little room is left and go over a few of the BIOS functions. The first BIOS functions are the Bcon functions.

Bcon functions are used to communicate with one of the devices the BIOS talks to. The ST can talk to the parallel port, the serial port, the MIDI, the screen and keyboard and the keyboard CPU with the Bcon functions. The Bcon functions are: Bconstat, Bconin, and Bconout. Bconstat is used to see if a character has arrived. The Bconstat function can be used with the serial port, keyboard and MIDI.

To use the Bconstat function, you must specify which device number you want to check. All of the Bcon functions need to know which device you are talking about. The devices numbers are:

0 parallel port
1 serial port
2 console device (screen & keyboard)
3 MIDI port
4 keyboard CPU

Both the MIDI and keyboard CPU talk to the ST through 6850 serial I/O chips. Bconstat(x) will return 0 if there is no character available. If a character has been received, Bconstat(x) will return -1. As an example, Bconstat(2) will return -1 if a key has been pressed.

Using these functions from C is very easy.

```
stat = Bconstat(1);
if (stat ! = 0) printf
("The modem has received a character.n");
```

The Bconin function is used to get a character from one of the devices. Bconin(2) would get a character from the keyboard. You should note that Bconin() does not return until it has received a character. If you use Bconin(2) and the operator does not press a key (maybe out having a cup of coffee,) the program will simply wait until a key is pressed, which may be a long time.

Bconout is used to send a character to one of the output devices. Bconout(0, 'x') will send an x to the printer.

While the Bcon functions appear simple enough on the surface, but there are hidden complexities. First, the I/O performed with these functions is stream I/O. If you press several keys on the keyboard, all the characters go into a keyboard buffer. This means that when you perform a Bconin(2) call, you really get a

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Randy's Atari ST Column
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In short, you really have to look at and play with DB Master One to appreciate it and realize its full potential.

"Epson compatible" for the Atari ST may not necessarily be true. I was using a Gemini 10 X when I got my Atari ST and when I hit the screen dump (ALT-help) I got a screen dump all right, but there was a thin white line separating each pass that the printer made. After talking with some folks it appears that the screen dump utility assumes that your printer can do n/216 line spacing, which the Gemini does not support - the best it can do is n/144. I replaced the 10X with an IBM Proprinter which suits me to a tee; but I hope SOMEONE at Atari, or DRI, or whoever comes up with a more universal printer driver that will handle the multiudes of printers on the market. The authors of graphics products shouldn't have to write their own drivers for lack of foresight on the part of the Atari ST's designers.

TOS ROMs are out now so it won't be much longer before you can free up that almost 20 K worth of OS in memory and give yourself more free menory for ST BASIC and/or RAM-disks. (I'am still waiting for my ROMs it will be interesting to see how long it takes to get them.)

Next month: Habba Hippo-C, OSS Personal Pascal and MichTron's BBS. ●

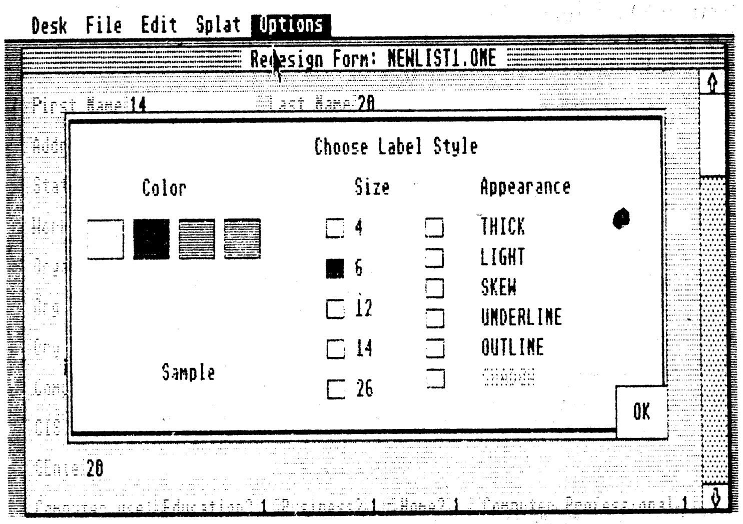

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Fig. 6 — DB Master One Label Style Dialog

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750K The Safe Way
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sucker. The best thing for unsoldering an ST appears to be a desoldering iron from Radio Shack that has a built-in bulb.

5. A couple of feet (4 or 5) of wire-wrap wire. If you can get three different colors, it will help.

6. Phillips screwdriver, long-nosed pliers, wire stripper, tweezers, etc.

Also, I recommend checking your work as you proceed. My plan allows you to do that. Periodically you pause, take a deep breath, and reassemble your computer. You try to boot up the computer. If it doesn't perform as it should, you know you've made a mistake. More important, you're sure it's in the steps you've just finished. Best of all, with my scheme, you can, at any time, return the machine to its original configuration. That also minimizes the risk and the headaches.

What parts are required for this project? What do you have to do?

To begin, you will need 24 of the 256K 150 ns chips (41256), a 74S157, and a 74LS139, and a 74LS138. You should have two 14 pin sockets and 17 16-pin sockets, a small perforated PC board, a DIP jumper, one 1K resistor, and two bypass capacitors.

Look at Figure 1. A word of caution about the new RAM chips you just bought, don't take them out of the shipping tubes until you need them. When you do get ready to use them, take proper precautions against static electricty; the 256K RAM chips can be destroyed by static electricity. Find U65 on your Sanyo's CPU board. I'll assume you already know how to disassemble your computer, and that you have the board now sitting in front of you. Locate pin 8 and pin 9 of U65. We could turn the board over and cut the traces before they reach the pin. I suggest that you not do that. I want you to chop off the pins between the IC and the board. Leave enough of the pin that you can bend it up.

I cut the pins on the chip, rather than the leads on the board. The rule is simple: Don't mess with the CPU board unless you have to. Use a pair of tiny clippers and snip off the 8 and 9 pins of U65. Bend both pins up, connect them, and solder a wire running from the pins to ground, pin 7 of the same chip is okay.

How are you going to do the cutting? Not much room. Such a small space. You'll have to have a pair of tiny cutters.

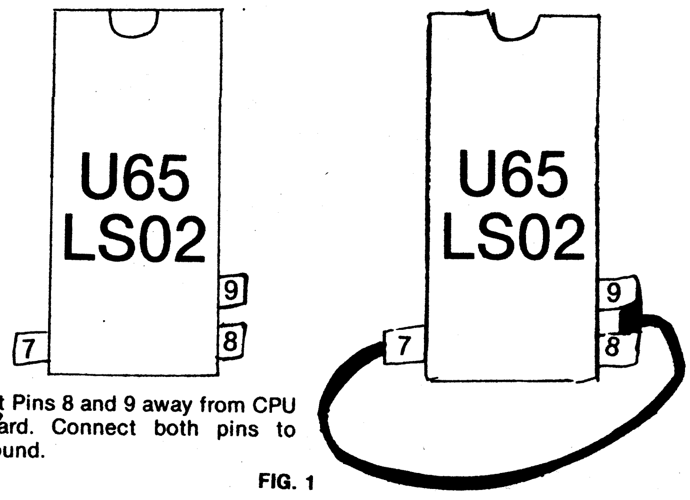
These two pins, pins 8 and 9, are connected to address lines A18 and A19. What they are doing is telling the computer that you have no memory above 256K. If there's more than 256K total in the four RAM banks, the system isolates the memory. The Sanyo was built with a maximum of 256K in mind. The designers said, "Hey, who needs any more than 256K. Nobody can use up that much memory!" Well, they were wrong.

Now, we're going to tie pins 8 and 9 low. In other words, we'll solder a wire from the two pins to ground, so that they are always low. Thus, the Sanyo will think or believe that its memory limit has not been exceeded. As far as the hardware is concerned, we will allow 1 Meg of total RAM to be installed in the four banks.

When you've finished we can move on to the next step. The catch is that the Sanyo runs a memory test to locate its video memory. If the memory is operable above 256K, the computer tries to fix the video at 0800:0. That isn't what we want. We want to set the video at page 1, or 1C00:0.

So we'll patch the io.sys pro-

continued on page 136



Cut Pins 8 and 9 away from CPU Board. Connect both pins to ground.

FIG. 1

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750K The Safe Way

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gram. As always, before patching any program, make sure you have made two or three copies of the original. After putting aside the copies in a safe location, type "Debug Io.sys". Then type "u aaa". You'll see this on your CRT:

```
0BE4:0AAA 76 11 BA 00 10 EB
```

Type "e aaa" and change "76 11" to "EB 2D." Then enter "a aaa" to check the result, you should see this:

```
0BE4:0AAA JMP 0AD9
```

If that's correct, then type "w," and write the patched IO.SYS to disk. Now you have a system that should boot and place the video at page 1, 1CCC to 1FFF, no matter how much memory you have in your machine.

You should reassemble your computer at this stage and reboot it. Everything should work fine. If it doesn't you've made a mistake. At this point, though, you still cannot read and write to memory locations above 256K. You have to install the 256 RAMs to do that.

The next step is to remove IC U82, a 74LS138. (See Figure 2). You will destroy this chip, in the process. You should get it out without damage to the board. Remember, an LS138 is worth only 39 cents, while you'll have to spend hundreds to replace the board. I use the same clippers to cut each pin as close to the chip as possible. When the last pin is out and you've cleaned and inspected the spot, use a desoldering iron, remove the pins and install in a socket. Now, take that 74LS138 IC you've bought and plug it into this socket. Reassemble your computer again. Your computer should still boot on command. If it doesn't, you've got a problem with this section. There's either a solder bridge, or you've inadvertently cut a tiny trace on the board.

Many readers will disdain this method. They'd prefer going ahead with the job, finishing it, and then seeing if it all works. I've done that. I'll admit it's more fun to troubleshoot when you don't know where to start and what to try. In this case, however, I'd suggest the slower, more methodical approach. If you've made a mistake, you know where to look for it.

Believe me, in a delicate undertaking such as this, you can run into unexpected problems.

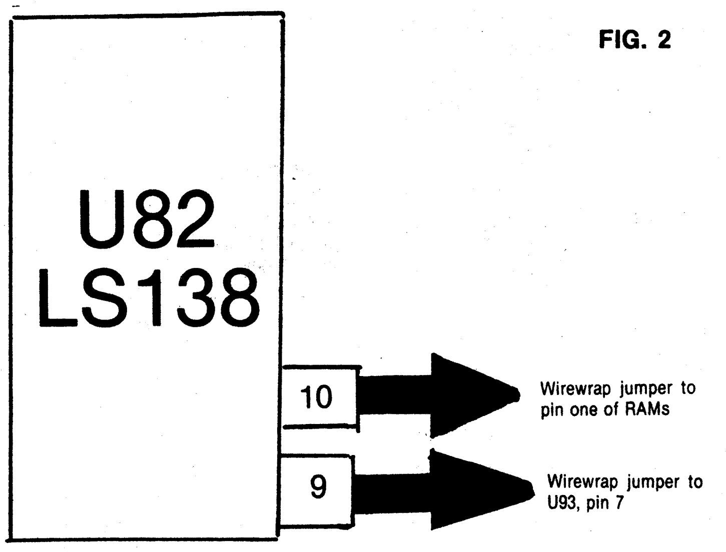
Now for the jumpers. Solder a wirewrap wire from U82, pin 9, to U82 socket (the IC you've just removed) pin 10. Solder another wirewrap wire into U82, pin 10. Allow yourself a foot or two of wire, before you cut it off. For the time being, leave that wire dangling in space. We'll get back to it in a moment. However, when and if you reinstall the LS138, remember to bend up pins 9 and 10.

Now for the all important RAM chips. Those first two banks of 64Ks have got to come out. No way around it. And, again, I recommend that the sixteen 64K chips that are soldered onto the board be destroyed. Do this rather than trying to save them. Believe me, I know from experience. The CPU is more important than the RAMs. Destroy the RAMs and save the board.

You want to save the RAMs, you say? Those sixteen RAM chips that are soldered onto the board are worth money! How much are they worth? How

continued on page 139

FIG. 2


U82
LS138
10
9
Wirewrap jumper to pin one of RAMs
Wirewrap jumper to U93, pin 7

Remove U82 and Replace with DIP socket and jumper

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Hacking The Atari ST
continued from page 134

character from the keyboard buffer not from the keyboard itself. The distinction is that if a key were to come from the keyboard itself, you would know that you were safe using the code in program 1.

The problem that crops up with stream I/O is that the operator may have held down the Y key for a little bit too long when answering the previous question. If that happens then the call Bconin(2) call may get one of the Y's left over from the last question. If that happens, "Do you want to continue? (Y/N)" just flashes on the screen and the program plows blindly onward while the operator sits there wondering what happened.

The way to handle this problem is to write a little routine that makes sure there are no characters left in the keyboard buffer. (See program 2).

This has been a little more work, but now we are sure that the Y we get is an answer to the question we just asked, not something that was left in the buffer from before.

The stream I/O has its advantages and disadvantages. We just saw a case where the stream I/O caused more work for us, but it can also make life easier. If you get a little busy with some code in a terminal package, the characters received by the modem will still be there waiting for you. Without stream I/O, these characters would have been lost.

The ST uses stream I/O on the output function Bconout also] This means that ·Bconout will really send a character to a buffer. When a device has finished sending one character it looks to see if another one is available in the buffer, if there is one, it gets that character from the buffer and sends it.

This can cause all sorts of fun. If you are working on some code, and there is a problem that causes bombs to appear on the screen, you will try and track down which line of code is causing the problem. An easy (and common) way to do this is to insert trace statements. An example will help illustrate.

```
printf("Ready to try setting DTR line.n");
Ongibit(0x40);
printf("DTR line set.n")'
```

The trouble with this approach on the ST is that it doesn't really tell you where the problem is. The characters are sent to the screen buffer by the printf statement, but they only appear on the screen later when the CPU can get around to putting them on the screen. That means that the second message may have been sent to the buffer, but does not appear on the screen when the error occurs. You may think hat the machine blew up on the Ongibit () call, when in fact it did that just fine and blew up later, before the message was output to the screen.

If you use this technique to track down errors, you will need another routine:

```
VOID delay(t)
int t;
/* this routine returns after about
   t milliseconds */
{
int x;
while (t-- >0) for (x = 0;x < 175;x++);
}
```

We can rewrite the trace like this:

```
printf("Ready to try setting DTR line.n")'
delay(1000);
Ongibit(0x40);
printf("DTR line set.n");
delay(1000);
```

This way the message has time to finish printing on the screen before the statements are executed.

A Quick Wrap-Up

Atari ST Internals from Abacus Software. Written by K. Gerits, L. Englisch and R. Bruckmann. ISBN 0-916439-46-1 $19.95. Recommended, very useful. A disk of the demo programs from the book is also available. This book can be found in many larger bookstores and some computer dealers. Contact: Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510. (616) 241-5510

Programming the 68000 from SYBEX. Written by Steve Williams. ISBN 0-89588-133-0 $22.95. A must for anyone serious about the 68000. The book can be found in larger bookstores. If you order from SYBEX directly, include $2 for shipping and handling. Contact: SYBEX, Inc., 2344 Sixth St., Berkeley, CA 94710. (800) 227-2346

Atari ST developers kit. $300 from Atari Corporation. Not for beginners. You must be serious and experienced to use this. You get a C compiler, Editor and thousands of sheets of documentation. Contact: Richard Frick, Atari, 1196 Borregas Ave., Sunnyvale, CA 94088. (408) 745-4926

Bconstat, Bconin and Bconout. These functions are used to send and receive characters to/from the parallel port, serial port, MIDI port, console and keyboard CPU. ●

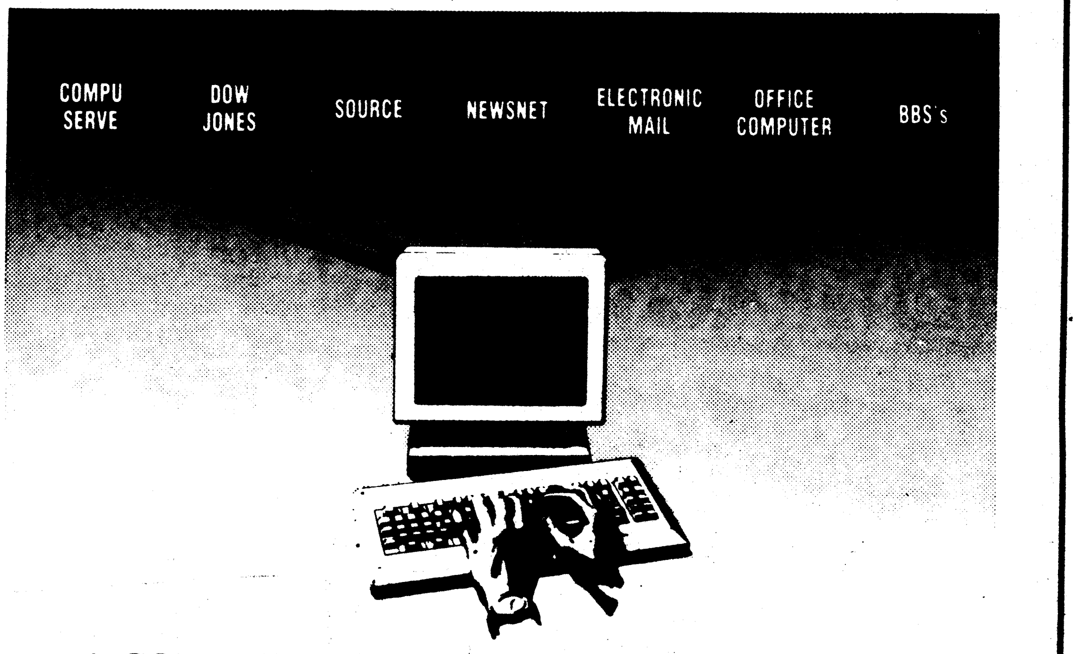
```
printf("Do you want to continue?  (Y/N)  ");
FOREVER
    {
    c = Bconin(2);
    if (c == 'Y')
        {
        printf("Yesn");
        goto next;
        }
    }
next: printf("Ok, now we will...");
```

Program 1

```
VOID drain()
/* this routine drains the keyboard buffer */
{
int st;
FOREVER
    {
    st = Bconstat(2);

    if (st == 0) return;

    Bconin(2);
Our code will now look like:
drain();

printf("Do you want to continue?  (Y/N)  ");

FOREVER
    {
    c = Bconin(2);
    if .(c == 'Y')
        {
        printf("Yesn");
        goto next;
    }
next: printf("Ok, now we will...");
```

Program 2

INTELLICOM



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Applying The Atari

continued from page 70

diskette is booted. You can save the April's two-column directory program (SAVE "D:DIR") and then have it run automatically whenever you boot a disk.

Mirror Graphics

If you've ever tried to manipulate an Atari graphics screen with Atari BASIC, you know that it can be a difficult task. One such manipulation is the mirroring of a graphics screen. Mirroring a graphics screen can be likened to folding a piece of paper with wet ink on it. After folding, each side of the paper has the reverse image of the other.

The mirroring program presented this month actually contains two routines. One is an X-axis mirror; it copies the left side of the screen to the right side and vice versa. The other is a Y-axis mirror. It mirrors the top and bottom of the screen. A BASIC program to mirror a screen might function satisfactorily in a graphics mode with few pixels (such as GRAPHICS 3 or 4). However, the slowness of BASIC makes high-resolution mirroring extremely impractical. Consequently, the mirroring routines have been written in machine language to allow high-speed mirroring of even high-resolution screens.

DEMONSTRATION 1

```
5 REM MIRROR GRAPHICS DEMO #1
10 GOSUB 25000:POKE 205,20:POKE 206,95
20 GRAPHICS 22:COLOR 1
30 PRINT #6;CHR$(125);
40 POKE 708,PEEK(712)
50 FOR I=1 TO 4
60 DRAWTO RND(0)*159,RND(0)*95
70 NEXT I
80 A=USR(1536):A=USR(1621,20*95-20)
90 POKE 708,RND(0)*255
100 POKE 712,255-PEEK(708)
110 FOR I=1 TO 500:NEXT I
120 GOTO 30
```

DEMONSTRATION 2

```
5 REM MIRROR GRAPHICS DEMO #2
10 GOSUB 25000:V=20:D=1
20 GRAPHICS 23:POKE 205,40:POKE 206,95
30 FOR I=1 TO 6:COLOR I
40 DRAWTO RND(0)*95,RND(0)*95:NEXT I
50 FOR J=1 TO 30
60 A=USR(1621,PEEK(205)*PEEK(206)-V)
70 V=V+D:IF V>21 OR V<19 THEN D=0-D
80 POKE 708,RND(0)*255
90 POKE 709,255-PEEK(708)
100 NEXT J
110 GOTO 20
120 POKE 712,255-PEEK(708)
130 FOR I=1 TO 500:NEXT I
140 GOTO 30
```

Type in the Mirror Graphics subroutine and LIST it to diskette or cassette so it can be merged with your BASIC programs.

To use the mirrored graphics, your BASIC program must first GOSUB 25000. This loads the machine langauge mirror routines into memory. You need to GOSUB 25000 only once during program execution.

When you are ready to mirror a screen, it is necessary to tell the routines the size of the screen you are mirroring. This is done by poking the number of bytes per line into location 205, and the number of lines per screen into location 206. *Table 1* shows the values you should poke into these locations for each graphics mode.

Once locations 205 and 206 are set, you can begin mirroring. For an X-axis mirror, use:

A = USR(1536)

This copies the left side of the screen to the right and vice versa. For a Y-axis mirror, use:

**A = USR(1621,PEEK(205)*
PEEK(206)-PEEK205))**

This copies the top of the screen to the bottom and vice versa. The PEEK(205)*PEEK(206)-PEEK(205) in the above statement tells the mirror routine where the last screen line resides. By changing this value, some interesting effects can be obtained, as you will see later in a demonstration program.

The Y-axis mirror will work properly in all graphics modes, including text modes. The X-axis mirror will function properly in GRAPHICS 4, 6, 8 and 14. However, GRAPHICS 3, 5, 7, 9, 10, 11 and 15 will not mirror perfectly, since the X-axis routine mirrors the bits of the screen, not the actual pixels. In the single-color modes, each pixel is represented by one bit, and the screen is mirrored perfectly. In the multicolor modes, however, each pixel is represented by more than one bit, since two bits (GRAPHICS 3, 5, 7, and 15) or four bits (GRAPHICS 9, 10 and 11) are used to describe the color of the pixel. Consequently, when a multicolored screen is mirrored, the mirrored colors will not necessarily be the same as the original ones, albeit the actual image itself will mirror exactly. You might even take advantage of the shifted colors to create various effects. The Y-axis mirror routine does not alter the colors when mirroring.

MODE	POKE 205	POKE 206
GRAPHICS 3	10	20
GRAPHICS 3+16	10	24
GRAPHICS 4	10	40
GRAPHICS 4+16	10	48
GRAPHICS 5	20	40
GRAPHICS 5+16	20	48
GRAPHICS 6	20	80
GRAPHICS 6+16	20	96
GRAPHICS 7	40	80
GRAPHICS 7+16	40	96
GRAPHICS 8	40	160
GRAPHICS 8+16	40	192
GRAPHICS 9	40	160
GRAPHICS 9+16	40	192
GRAPHICS 10	40	160
GRAPHICS 10+16	40	192
GRAPHICS 11	40	160
GRAPHICS 11+16	40	192
GRAPHICS 14	40	160
GRAPHICS 14+16	40	192
GRAPHICS 15	40	160
GRAPHICS 15+16	40	192

With the Mirror Graphics subroutine still in memory, add *Demonstration 1* and RUN it. In a few seconds, the program will display four-way mirrored images. Note the use of the X-axis and Y-axis mirrors on line 80. This is an obvious application of the mirror routines.

Type in *Demonstration 2*, again leaving the Mirror Graphics subroutine in memory. When you RUN the program, lines 30 and 40 randomly draw on a GRAPHICS 7 screen. Line 60 contains the Y-axis mirror, but notice that the PEEK(205)*PEEK(206)-PEEK(205) has been replaced by a PEEK(205)*PEEK(206)-V. V varies from 18 to 22 and then back to 18 repeatedly. This serves to "fold" the screen at alternating angles and the effect is unique and mesmerizing.

Next Month

We'll enter the long-awaited budget program. It's full-featured and is user friendly as well. We'll also answer more reader mail.

Reader's questions, comments and contributions are welcome. Please enclose a self-addressed, stamped envelope (SASE) for a personal reply.

A diskette of the programs listed in this month's column is available from the author for $7.00, postpaid. Please make checks payable to "Jeff Brenner" and specify your disk drive model.

"Program Perfect" is a utility used to check for typing errors while entering programs from this column. Readers may send $5.00 for a diskette or a SASE for a listing of this program.

Address all correspondence to: Jeff Brenner, "Applying The Atari 5/86", c/o *Computer Shopper*, P.O. Box F, Titusville, FL 32781-9990. ●

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